REMARKS

Claims 1-24, 26-30, 32-45, 48 and 49 were presented for examination. Claims 1-24, 26-30, 32-45, 48 and 49 were rejected. Claim 49 has been amended.

Statement of the Substance of the Interviews

On October 3, 2007, Matthew A. Molloy and Kristina E. Swanson, on behalf of the Applicant, conducted a telephone interview with Examiner Cynthia K. Lee. In the Office Action, all claims were rejected. The Applicants sought to clarify the basis of the 35 U.S.C. § 112, first and second paragraphs rejection to claims 1-24, 26-35, 48 and 49 and the objection to the Specification. Mr. Molloy , Ms. Swanson and the Examiner discussed how it is well known in the art of fuel cells to have a controller control the amount of humidity in which the fuel cell operates by pointing to U.S. Patent Nos. 6,376,111 and 7, 258,937; both of which are assigned to the same entity as the present invention. Additionally, Mr. Molloy, Ms. Swanson and the Examiner briefly discussed the appropriateness of the 35 U.S.C. § 112, first and second paragraphs claim rejections regarding the reactant output having a relative humidity that exceeds 150% during the interview. However, it was determined during the interview that a discussion with the inventor, Jeannette Owejan (nee O'Hara), would help clarify some of the more technical features of the invention.

Therefore, on October 5, 2007, Kristina E. Swanson, on behalf of the Applicant, and Jeannette E. Owejan, the inventor, conducted a telephone interview with Examiner Cynthia K. Lee. Inventor Owejan provided the technology background as to how the fuel cell produced and operated with a reactant outputs that exceeds 150% relative humidity. Inventor Owejan stated that it is well known in the art of fuel cells to describe the reactant output in terms of percentage of relative humidity.[1] In the art, relative humidity percentages greater than 100% typically

1 Please *see e.g.*, Owejan et al, *Investigation of Fundamental Transport Mechanism of Product Water from Cathode Catalyst Layer in PEMFCs*, Proceedsing of FEDSM2007 5th Joint ASME/JSME Fluids Engineering Conference, July 30 - August 2, 2007, San Diego, CA, for the discussion on page 5 regarding estimated exhaust RH of 110% and 300%.

represent a reactant output as a mixture of a 100% humidified gas plus any surplus water that is produced during the fuel cell reaction itself (i.e., if the stoichiomeric measured and calculated values for the reactant output are greater than 1, then the relative humidity of the output will be described as being greater than 100%). As it is well known, the reaction of the fuel cell consumes gas and makes water. Therefore, the reactant output tends to be wetter with less gas than the inputs which means the gas that is present in the output will be saturated (i.e., have a relative humidity of about 100%). The relative humidity at the output can both be calculated as well measured if the humidified reactant output is allowed to condense. The pressure and temperature are controlled by a controller at both the inputs and outputs to remain roughly the same in order to maintain 100% saturation of the gas at both the input and output. As it is known in the art, a fuel cell membrane gives its best performance while operating at a 100% relative humidity. Therefore, the input gases typically enter the fuel cell fully saturated. After speaking with the Inventor Owejan during the interview, Examiner Lee indicated that her objection to the Specification and her rejections to claims 1-24, 26-35, 48 and 49 under 35 U.S.C. § 112, first and second paragraphs, would be withdrawn regarding how the fuel cell could have a reactant output exceeding 150% and how the fuel cell could operate with such a reactant output.

Objection to the Specification

After the interview of October 5, 2007, the Examiner indicated her objection to the Specification will be withdrawn as it is now clear that how a reactant output may exceed 150% relative humidity using the nomenclature of output relative humidity as it is well known in the art of fuel cells and how the controller is used to regulate temperature, pressure, humidity, flow rates of the first and second reactant inputs and combinations thereof as known in the art.

Rejections Under 35 U.S.C. § 112

Claim 49 was rejected under 35 U.S.C. § 112, first paragraph as failing to comply with the written description requirement

Accordingly, claim 49 has been amended to comply with the written description

requirement. Applicant requests that the Examiner withdraw her rejection to claim 49.

Claims 1-24, 26-35, 48 and 49 were rejected under 35 U.S.C. § 112, first paragraph as failing to comply with the written description requirement

Applicant respectfully points out that the "present invention is not directed to the specific mechanisms by which the fuel cell .. converts a hydrogenous fuel source to electrical energy" (page 5, lines 27-28). Instead, the present invention is directed to tailoring the diffusion media of the fuel to address water management issues present in differing operational humidity levels within the fuel cell (page 2, lines 13-17). The recitation of a humidified reactant output that exceeds about 150% or between 100% and 150% represent conditions to which the invention tailors the diffusion media to adapt to water management issues at these relative humidity operating conditions. Further, after the interview of October 5, 2007, the Examiner indicated that is was now clear how relative humidity over 150% was achieved (i.e., molar fraction of water at the output multiplied by total pressure divided by the total amount of water vapor pressure the gas can hold at that particular temperature) and that such conditions are well known in the art of fuel cells. Therefore, Applicant requests that the Examiner withdraw her rejection to claims 1-24, 26-35, 48 and 49.

Claims 1-24, 26-35, 48 and 49 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Again, Applicant respectfully points out that the "present invention is not directed to the specific mechanisms by which the fuel cell .. converts a hydrogenous fuel source to electrical energy" (page 5, lines 27-28). Instead, the present invention is directed to tailoring the diffusion media of a fuel cell to address water management issues present in differing operational humidity levels within the fuel cell (page 2, lines 13-17). The recitation of a humidified reactant output that exceeds about 150% or between 100% and 150% represent conditions to which the invention tailors the diffusion media. Further, after the interview of October 5, 2007, the Examiner

indicated that is was now clear how relative humidity over 150% was achieved and that such conditions are well known in the art of fuel cells. Therefore, Applicant requests that the Examiner withdraw her rejection to claim 1-24, 26-35, 48 and 49.

Rejections Under 35 U.S.C. § 103(a)

Claims 1-3, 5, 9-11, 15, 17, 20-24, 27-30 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al (US 2003/0157397) in view of Andrews et al (US 2002/0110714, now US 6,821,660), as evidenced by Yoshida et al (US 2003/0091891). Claims 14, 18, 19 and 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Andrews et al, as evidenced by Yoshida et al, as applied to claims 1 and 27, further evidenced by Cipollini (US 6,379,827). Claims 7, 8, 12, 13 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Andrews et al, as evidenced by Yoshida et al, as applied to claims 1 and 27 and incorporated herein. Claims 4 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Andrews et al, as evidenced by Yoshida et al, as applied to claim 1 and incorporated herein, further in view of Larson (US 2003/0134178). Claims 16 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Andrews et al, as evidenced by Yoshida et al as applied to claims 15 and 48, further in view of Zuber et al (US 2002/0041992). Claims 36-40, 44 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al, as evidenced by Yoshida et al, in view of Larson and Andrews et al. Claims 41-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al as evidenced by Yoshida et al, in view of Larson and Andrews et al as applied to claim 36, further evidenced by Cipollini. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Andrews et al, as evidenced by Yoshida et al as applied to claim 27, further in view of Fuglevand (US 2004/0214057; newly cited reference). Claims 1-3, 5, 9-11, 15, 17, 20-24, 27-30 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al (US 6,566,002; newly cited reference) as evidenced by Yoshida et al. Claims 14, 18, 19 and 32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al, as evidenced

by Yoshida et al, as applied to claims 1 and 27, further evidenced by Cipollini. Claims 7, 8, 12, 13, 31 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al, as evidenced by Yoshida et al, as applied to claims 1 and 27 and incorporated herein. Claims 4 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al, as evidenced by Yoshida et al, as applied to claim 1 and incorporated herein, further in view of Larson. Claims 16 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al, as evidenced by Yoshida et al, as applied to claims 15 and 48, further in view of Zuber et al. Claims 36-40, 44 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al as evidenced by Yoshida et al, in view of Larson and Yoshimoto et al. Claims 41-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al, as evidenced by Yoshida et al, further in view of Larson as applied to claim 36, further evidenced by Cipollini. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al in view of Yoshimoto et al, as evidenced by Yoshida et al as applied to claim 27, further in view of Fuglevand. These rejections are respectfully traversed.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *See* MPEP 2143. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Independent claims 1, 27, and 36 recite devices configured to convert a hydrogenous fuel source to electrical energy, wherein the devices comprise a first reactant input, a second reactant input, a humidified reactant output having a relative humidity of a humidified reactant output exceeding about 150% (claim 1), between (100 and 150% (claim 27), or below 100% (claim 36). The diffusion media comprises a diffusion media substrate and a mesoporous layer. The

diffusion media substrate comprises a carbonaceous porous fibrous matrix defining first and second major faces, and the mesoporous layer is carried along at least a portion of one of the first and second major faces of the substrate and comprises a hydrophilic carbonaceous component and a hydrophobic component. The hydrophilic carbonaceous component comprises a surface area of below about 85 m^2/g (claim 1), between about 200 m^2/g and 300 m^2/g (claim 27), or above about 750 m^2/g (claim 36). The hydrophilic carbonaceous component also comprises a mean particle size of between about 35 nm and about 70 nm (claim 1), between about 15 nm and 40 nm (claim 27), or less than about 20 nm (claim 36). None of the references, either singularly or in combination, teach or suggest all elements of claims 1, 27, and 36. In each of the independent claims, the diffusion media was tailored to specific water management baed on the condition of the relative humidity of the humidified reactant output.

<u>Claim 1</u>

As the Examiner acknowledges, the cited references are silent as to the relative humidity of the humidified reactant output streams as recited in claim 1. Andrews, the reference cited for teaching this claim element, discloses that its humidified reactant gas stream is maintained at a *set point temperature above the dew point temperature* of the humidified reactant gas; consequently Andrews does not teach that its humidified reactant output or its input are saturated since the temperature is set at a point *above* the dew point. *See* [0024] Regardless of the teaching deficiency, the Examiner modifies the Andrews (the reference cited for this claim element) through impermissible hindsight in order to teach relative humidity of above 150% RH for a humidified reactant output as recited in claim 1. Examiner is reminded that "the mere fact that prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. It is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the prior art so that the claimed invention is rendered obvious." *In re Fritch*, 23 USPQ2d 1780, 1783-4 (Fed. Cir. 1991). Here, the current application is the only reference that teaches the relative humidity of the output streams, and is also the only reference

that teaches devices, e.g. fuel cells, which are operable at conditions with a relative humidity over 100%. The Examiner's modification of the Andrews apparatus constitutes impermissible hindsight reconstruction, and is therefore an improper basis for a rejection under §103.

Additionally, Yoshimoto also teaches a fully saturated inlet gas. However, Yoshimoto teaches away from a reactant output gas having a relative humidity over 100% since, according to Yoshimoto, the resulting condensed water hinders fuel gas flow (see Col. 2 , lines 30-47). Further, Yoshimoto is silent on tailoring the diffusion media in order to manage the condensed water produced by the fuel cell operation as is disclosed in the claimed invention.

Moreover, none of the references, either singularly or in combination, teach or suggest a mesoporous layer with a hydrophilic carbonaceous component characterized by a surface area of below about 85 m^2/g and a mean particle size of between about 35 nm and about 70 nm. Barton, which is cited for teaching this claim element, discloses a surface area of about 50 to about 800 m^2/g; however, Barton provides no guidance that would lead to one of ordinary skill in the art to configure the surface area to below 85 m^2/g as recited in claim 1. Barton is silent as to particle size. Noting this deficiency, the Examiner cites Yoshida, which discloses a mean or average particle size of 30nm; however, Yoshida does not teach a mean particle size of about 35 nm to about 70 nm as recited in claim 1. As result, none of the references, either singularly or in combination, teach or suggest all elements of claim 1.

Claim 27

For the reasons provided in the arguments regarding claim 1, none of the references teach or suggest the relative humidity of between about 100% to about 150% for a humidified reactant output exiting the device as recited in claim 1. Furthermore, none of the references teach or suggest a mesoporous layer with a hydrophilic carbonaceous component having a surface area of between about 200 m^2/g and about 300 m^2/g and a mean particle size of between about 15 nm and about 40 nm as claimed. As stated above, Barton discloses a surface area of about 50 to about 800 m2/g; however, Barton provides no guidance that would lead to one of ordinary skill in the art to configure the surface area to between about 200 m^2/g and about 300 m^2/g as recited

in claim 1.

Moreover, as the Examiner acknowledges, Barton fails to teach that the mesoporous layer infiltrates into the diffusion media substrate to a depth of up to 10 μm as recited in claim 27. Noting this deficiency, the Examiner states that the carbon paper is porous, and thus must necessary infiltrate the adjacent microporous layer at a microscopic level. However, Barton is provides no teaching regarding infiltration of the carbon paper into the microporous layer, much less infiltration up to 10 μm. The only reference which teaches infiltration is the present application, which Examiner is barred from using to bridge the teaching gap. Yoshida, and the additional cited references, Cipollini, and Larson, do not cure the above noted deficiencies of Barton, thus the references, either singularly or in combination, fail to teach or suggest all elements of the claim 27.

Claim 36

Similar to claims 1 and 27, the cited references are silent as to the relative humidity of the humidified reactant output from the device as recited in claim 36. Additionally, none of the references, either singularly or in combination, teach or suggest a mesoporous layer having a hydrophilic carbonaceous component with a surface area of above about 750 m^2/g and a mean particle size of less than 20 nm. As stated above, Barton discloses a surface area of about 50 to about 800 m^2/g; however, Barton provides no guidance that would lead to one of ordinary skill in the art to configure the surface area to above about 750 m^2/g as recited in claim 36. Barton is silent as to particle size, and Yoshida fails to cure this teaching deficiency of Barton. Yoshida teaches a mean or average particle size of 30nm, not a mean particle size of less than about 20 nm as recited in claim 36. As result, none of the references, either singularly or in combination, teach or suggest all elements of claim 36. Accordingly, the rejections under §103 are believed to be overcome, and reconsideration is respectfully requested

Claims 2-24, 26, 28-30, 32-35, 37-45, 48 and 49 depend from the independent claims 1, 27 and 36 either directly or ultimately. These dependent claims are patentable for the same

reasons as presented above with respect to the claims from which they depend. Therefore, Applicant asserts that claims 2-24, 26, 28-30, 32-35, 37-45, 48 and 49 are also patentable over the prior art and requests that the Examiner withdraw her rejection thereof.

Conclusion

For the above reasons, the Applicant respectfully submits that the above claims represent allowable subject matter. The Examiner is encouraged to contact the undersigned to resolve efficiently any formal matters or to discuss any aspects of the application or of this response. Otherwise, early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
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